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Numerical simulation of 3D magnetic field and turbulence interaction in tokamak plasma using XGC1. JAE-MIN KWON, National Fusion Research Institute, S. KU, C.S. CHANG, Princeton Plasma Physics Laboratory, M.J. CHOI, National Fusion Research Institute, R. HAGER, Princeton Plasma Physics Laboratory — Understanding the physics of 3D magnetic field and turbulence interaction is critical for present and future tokamak experiments. In this work, we report our recent progress in numerical simulation of 3D magnetic field effects on plasma flow and turbulence using XGC1. Employing the full-f gyrokinetic simulation capabilities of XGC1 in realistic tokamak geometry, we perform extended neoclassical simulations including kinetic electrons for a tokamak plasma with assumed 3D magnetic field perturbations. From the simulations, non-axisymmetric kinetic equilibria with self-consistent 3D flows are obtained. Affected by the applied 3D fields, the plasma develops so called the vortex mode, which is mesoscopic convective flow driven by the 3D fields. Detailed analysis of the convective flow structure is presented. Then, using the numerically obtained non-axisymmetric kinetic equilibria, we study the impacts of the 3D fields on micro-instabilities. Both the neoclassical equilibrium flow and mesoscopic vortex mode are important in this study, and it is presented how these flows and combined ExB shearing affect the micro-instabilities, especially their spatial distributions. We also discuss the implication of the modified micro-instabilities on turbulence and transport near the resonant region with applied 3D magnetic fields.

Jae-Min Kwon
National Fusion Research Institute

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